Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In The Matter Of:

Wireless Telecommunications Bureau Requests Targeted Comment on Wireless E911 Phase II Automatic Location Identification Requirements	)	CC Docket No. 94-102
	)	DA 99-1049

Comments of Cell-Loc Inc.

Cell-Loc Inc. ("Cell-Loc") submits these comments in response to the Wireless Telecommunications Bureau's June 1, 1999 Public Notice which requests comments on wireless E911 Phase II automatic location identification requirements. In particular, Cell-Loc submits comments with respect to the clarification or modification of methodology for determining ALI accuracy under Phase II. These comments address the difference between the original accuracy standard of 125 m RMS and the proposed accuracy standard of 90 m CEP (Circular Error Probable). In this document it is demonstrated that the use of CEP in place of RMS is not in the best interest of public safety.

When evaluating any position estimation technology, at least two factors are of importance - availability (sometimes referred to as reliability) and accuracy. In the case of wireless telephones calling 911, availability refers to the percentage of wireless 911 calls the positioning technology or system is able to position. For the

percentage of calls which the system is able to position, the second factor, of course, is the accuracy of the position estimate.

The FCC mandate addresses both of these factors. In the mandate, the FCC specifies that all wireless 911 calls must be positioned. This necessitates 100% availability. The accuracy of the horizontal position estimates is to be 125 m DRMS (Distance Root Mean Squared). However, the two criteria of availability and accuracy are often combined. This is most likely due to the empirical nature in which accuracy measures such as DRMS and CEP are determined. Strictly speaking, accuracy measures such as DRMS and CEP should be derived from the estimated parameter covariance matrix which is a by-product of the position estimation process. Each position estimate has such a covariance matrix associated with it and therefore an accuracy measure such as DRMS and CEP can be calculated for each position estimate.

In practice, however, accuracy measures are often determined by comparing position estimates to the known position of the wireless telephone being located. CEP is defined as the 50% probability circle. If a horizontal position of (x, y) has been estimated for the wireless telephone, there is a 50% probability that the correct position is within a circle of radius CEP and centered at (x, y). The only way to empirically measure CEP is to make a number of position estimates and draw a circle centered at the known location and just large enough to encompass 50% of the position estimates. The radius of that circle is then taken to be the CEP. It is at this point that availability is often mixed into the accuracy measure. If for whatever reason, a position estimate cannot be provided, the temptation exists to group that

particular instance in the 50% of the results which fall outside the circle of radius CEP.

This concept may be extended to the broader case of position accuracy in all environments and situations. If a particular technology is able to estimate the position of individual wireless 911 calls with an accuracy of 100 m or better but it is only able to position 50% of the wireless 911 calls made, its CEP performance is still 100 m. However, this is very misleading. DRMS, on the other hand, is most rigorously calculated from empirical data in such a way that unlocated calls cannot be hidden in the accuracy measure. In other words, when using DRMS, availability must be clearly and separately specified. The equation to calculate DRMS from empirical data is

$$\mathrm{DRMS} = \sqrt{\frac{\sum_{i=1}^{N}\left[(x_i - x_T)^2 + (y_i - y_T)^2\right]}{N}}$$

where (x_i, y_i) is the ith position estimate and (x_T, y_T) are the known coordinates. Note that this equation assumes that there are *N* position estimates. Unlocated calls cannot be merely left out of the calculation and thereby hidden. It must be stated that either some calls could not be located or some other position solution such as Phase I must be used in the DRMS equation.

The above difference between CEP and DRMS is critical when consideration is made as to which is the better accuracy measure for wireless telephone positioning for E911. In addition to the ease with which unlocated calls may be hid in CEP, the practical method of calculating CEP allows large errors in the location estimation to lie outside the probability circle without affecting its radius. DRMS, on the other hand, is affected by all of the data when calculated by the equation above. Therefore, DRMS is a more revealing and truthful indicator of positioning accuracy than CEP.

Other parties have proposed that the original FCC mandate of 125 m DRMS be replaced by 90 m CEP. Although 90 m CEP suggests better accuracy than 125 m DRMS, this is not necessarily so given the positional error distributions of some wireless positioning systems. Take, for example, a system or technology which is not able to locate 100% of wireless 911 calls but when able to locate does so with an accuracy of 90 m. When, for whatever reason, the system is not able to locate a wireless 911 call, the next best solution is an E911 Phase I solution which corresponds to the location of the servicing base station. A typical error for a Phase I solution is 2 km. To compare CEP to DRMS for this particular scenario we derive DRMS from the following probability circles:

- **99% probability circle**

  90 m 99% CEP is **219.13 m** RMS

  $$90\,\text{m}\,99\%\,\text{CEP} \equiv \sqrt{0.99\times 90^2 + 0.01\times 2000^2} = 219.13\,\text{m RMS}$$

- **90% probability circle**

  90 m 90% CEP is **638.19 m** RMS

  $$90\,\text{m}\,90\%\,\text{CEP} \equiv \sqrt{0.90\times 90^2 + 0.10\times 2000^2} = 638.19\,\text{m RMS}$$

- **80% probability circle**

  90 m 80% CEP is **898.04 m** RMS

  $$90\,\text{m}\,80\%\,\text{CEP} \equiv \sqrt{0.80\times 90^2 + 0.20\times 2000^2} = 898.04\,\text{m RMS}$$

- **70% probability circle**

  90 m 70% CEP is **1098.03 m** RMS

  $$90\,\text{m}\,70\%\,\text{CEP} \equiv \sqrt{0.70\times 90^2 + 0.30\times 2000^2} = 1098.03\,\text{m RMS}$$

- **60% probability circle**

  90 m 60% CEP is **1266.83 m** RMS

  $$90\,\text{m}\,60\%\,\text{CEP} \equiv \sqrt{0.60\times 90^2 + 0.40\times 2000^2} = 1266.83\,\text{m RMS}$$

- **50% probability circle**

  90 m 50% CEP is **1415.64 m** RMS

$$90\,\text{m}\ 50\%\ \text{CEP} \equiv \sqrt{0.50 \times 90^2 + 0.50 \times 2000^2} = 1415.64\,\text{m RMS}$$

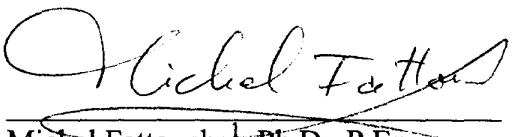
It is obvious from these examples that CEP does not accurately reflect the performance of a system which is able to position some calls with a high degree of accuracy (90 m) but others with a low level of accuracy (2000 m). An RMS accuracy measure, however, does not hide the presence of position estimates with poor accuracy. DRMS is the most technology neutral accuracy measure because it does not favor any one type of position estimation error distribution. If a positioning system locates some calls with very good accuracy and the remainder with poor accuracy, or if its position accuracy is more normally distributed, DRMS will more truthfully reflect the accuracy of the system than will CEP.

Since the FCC mandate pertains to E911 for wireless callers, public safety is of utmost concern in this discussion. The danger of using CEP as the accuracy measure for E911 location technology is the possibility of a system passing the FCC mandate but not being able to position all wireless 911 callers with an accuracy sufficient for emergency response personnel to reach the caller in need. A system which meets 90 m CEP (50%) is of little help to an individual whose E911 call cannot be located and the best position available is the servicing base station location. That individual would be far better served by a system which passes the 125 m DRMS requirement.

Cell-Loc contends that a change in the FCC accuracy standard from 125 m DRMS to 90 m CEP is not in the best interest of public safety and could ultimately lead to higher liabilities for wireless carriers.

Respectfully submitted,

CELL-LOC INC.



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